STUDIES IN CEREAL DISEASES

VII

SULPHUR DUSTING OF GRAIN PLOTS FOR CONTROL OF RUST

By
F. J. GREANEY

DOMINION RUST RESEARCH LABORATORY
WINNIPEG, MAN.

DIVISION OF BOTANY
DOMINION EXPERIMENTAL FARMS

H. T. GÜSSOW, DOMINION BOTANIST

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Cereal rusts are a limiting factor in grain production. Rust is liable seriously to reduce the quality and yield of registered seed and grain grown for experimental and especially for exhibition purposes. Although it is well known that the development of resistant varieties presents the best method of controlling cereal rusts, there has recently been a widespread interest among experimentalists and growers in the possibilities of preventing rust by dusting.

Since 1925, extensive field experiments have been carried on at the Dominion Rust Research Laboratory, Winnipeg,—a branch laboratory of the Division of Botany—to determine the effectiveness and practical value of sulphur dusts for the prevention of cereal rusts. The results were most satisfactory, and have shown that leaf and stem rusts of wheat, oats and barley may be prevented by properly dusting the growing plants with a suitable sulphur dust.

Although the dust treatment is effective in preventing rust it cannot be recommended as a general farm practice. To dust small experimental plots thoroughly with a hand operated duster is relatively easy; to dust larger fields thoroughly and profitably with a large machine is another problem. If dusting is to be a practical method of rust control, it will, of course, depend finally on the net profit to the farmer. In this respect the problem is similar to any other spraying and dusting problem. At the present time it can be stated definitely that leaf and stem rusts of wheat, oats, and barley may be practically and effectively controlled in experimental plots by dusting.

Relatively small amounts of a satisfactory sulphur dust, properly applied, will prevent rust and other leaf and stem diseases of cereals, increase yield, and improve the grade. The methods outlined here should be of immediate and distinct commercial value to producers of Registered and Elite Stock Seed. A dusting schedule showing concisely when and how to dust grain plots is included. This information will be of value to seed growers, grain exhibitors, and Canadian experimentalists, wherever destructive outbreaks of cereal rusts occur.

Sulphur Dusting Experiments

Wheat dusting experiments for the prevention of rust were carried on at Winnipeg during the period 1925 to 1930. Each year, Marquis wheat was sown in long rectangular plots, separated by pathways, from which it was possible to dust thoroughly each plot without injury to the standing grain. Dusting operations were commenced just as soon as rust appeared in the district but not necessarily on the plots. Thereafter, the plots were treated at regular intervals until the wheat was ripening. At each dusting, sulphur was applied at a given rate with an ordinary hand duster.

In an attempt to study some of the important factors influencing the effectiveness of dusting for the prevention of rust, experiments were arranged to determine the proper time to begin dusting, the effect of different rates of application, the most satisfactory interval between dustings, the most desirable brand of sulphur dust, the smallest number of dustings necessary to control rust,

FIG. 1.—Heads of Marquis wheat grown at Winnipeg. Left: not dusted, heavily rusted. Right: dusted, not rusted.

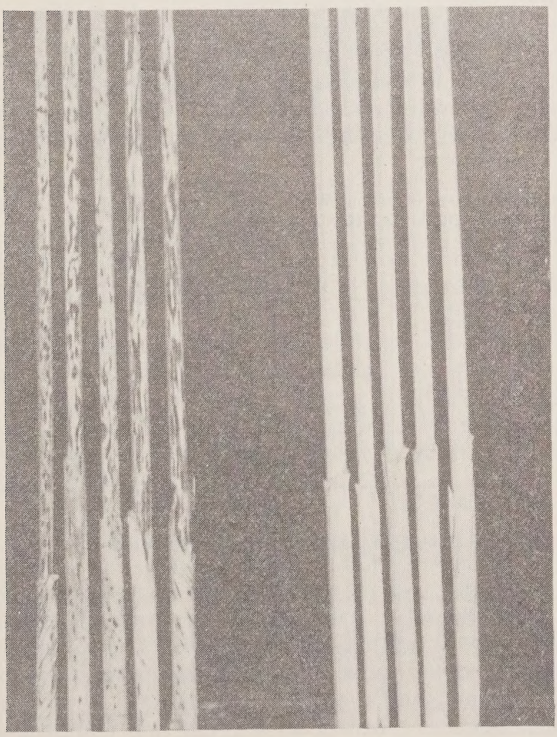

FIG. 2.—Stems of Marquis wheat grown at Winnipeg. Left: not dusted, infected with rust. Right: dusted, stems clean and healthy.

the relative effectiveness of different methods of application and timeliness of dust application. The dusting schedule followed, and the results obtained in some of the tests made in 1925, 1927 and 1930 are given in table 1. Stems, heads, and kernels, of dusted and undusted Marquis wheat grown at Winnipeg, in 1930, are shown in figures 1, 2 and 3.

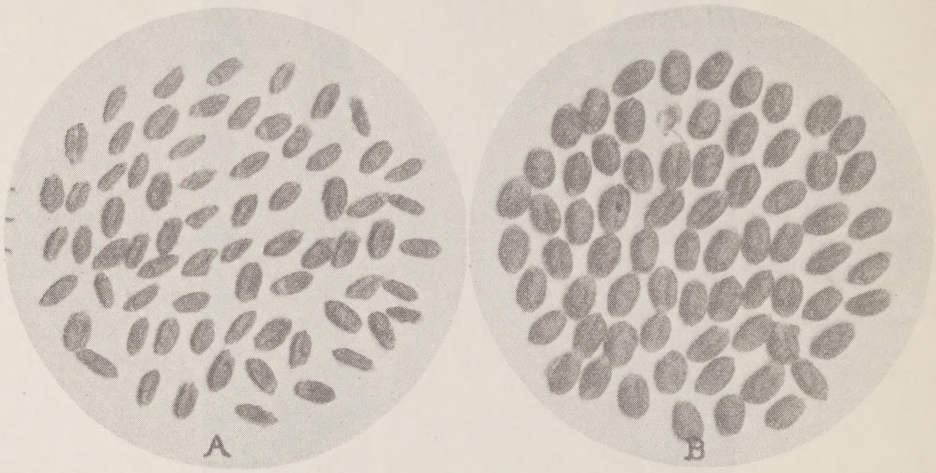

FIG. 3.—The effect of controlling rust on the size and plumpness of kernels. A—Wheat not dusted (bushel weight 42 pounds). B—Dusted wheat (bushel weight 61 pounds).

The results presented in table 1 are very similar to the results obtained in many other experiments and indicate clearly that relatively small amounts of a suitable sulphur dust, properly applied, will markedly reduce leaf and stem rust infection, increase yield, and improve the grade. In general, the results of the six years work show that the leaf and stem rusts of wheat, oats and barley can be effectively and economically controlled by dusting the growing plants with sulphur. In 1925, dusting increased the yield 33 bushels per acre; in 1927, 18 bushels per acre; and an increased yield of 21·7 bushels per acre was obtained in 1930. In 1925 and 1930, dusting improved the marketable grade from "Feed Wheat" to No. 1 Northern.

TABLE 1.—RESULTS OF DUSTING MARQUIS WHEAT WITH SULPHUR DUST AT THE RATE OF 30 POUNDS PER ACRE, PER APPLICATION, AT WINNIPEG, IN 1925, 1927 AND 1930

Year*	Dusting Period	Interval between dustings in days	Date Dusted			Total No. of dustings	Per cent leaf rust at harvest	Per cent stem rust at harvest	Yield in bus. per acre	Grade
			July	August	September					
1925	July 2 to August 25	Check	—	—	—	0	70	85	17·7	Feed
		14	2, 16, 30	13	—	4	65	80	20·3	5
		7	2, 9, 16, 23, 30	6, 13, 20	—	8	60	55	35·1	3°
		3–4	2, 5, 9, 12, 16 19, 23, 26, 30	2, 6, 9, 13 16, 20, 24	—	16	20	25	50·8	1°
1927	July 18 to September 9	Check	—	—	—	0	62	87	12·2	Feed
		14	18	1, 15, 29	—	4	53	65	15·5	6
		7	18, 25, 29	1, 8, 15, 22, 29	5	8	30	35	20·6	5
		3–4	18, 22, 25, 29	1, 5, 8, 12, 15 22, 26, 29	5, 9	15	20	15	30·5	5
1930	July 14 to August 14	Check	—	—	—	0	42	95	6·1	Feed
		14	14, 28	11	—	3	35	77	9·8	6
		7	14, 21, 28	4, 11	—	5	20	43	18·1	3°
		3–4	14, 18, 21, 25 28	1, 4, 8, 11, 15	—	10	5	7	27·8	1°

*Severe rust epidemic years.

Dusts and Dusting Apparatus

The sulphur dusting method is relatively simple and the apparatus and supplies required are not over-expensive. For plot work, a hand duster of the type illustrated in figure 4 will be found satisfactory. These machines are light and durable and when properly operated they distribute the dust uniformly over a strip at least four-feet in width. Hand dusters can be purchased from seed firms and dealers in Canada at prices ranging from 10 to 20 dollars each. Although most of these machines are not provided with any carefully controlled means of varying the rate of dust application, very close approximations to any

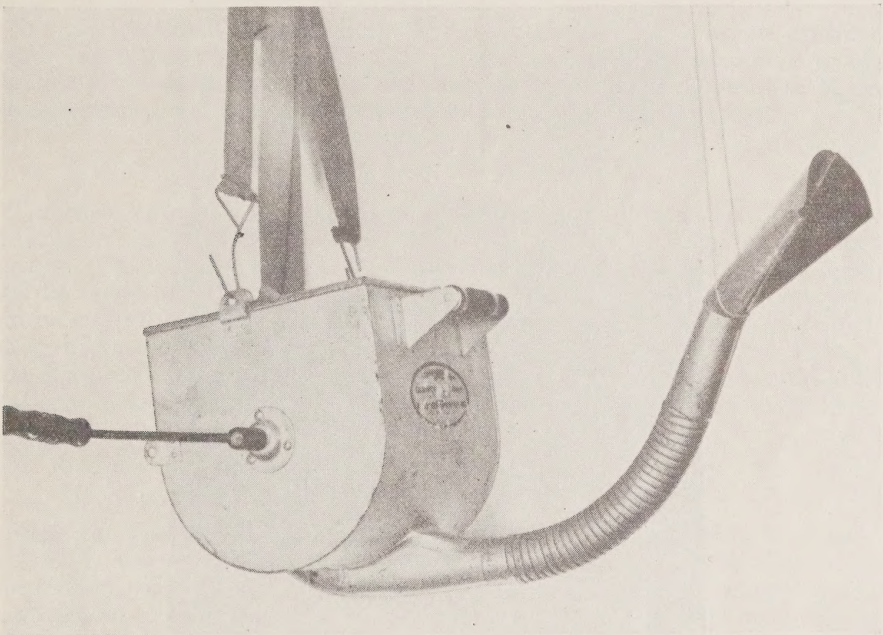

FIG. 4.—Hand duster used for dusting cereal plots.

desired rate can be secured if, after adjusting the valve opening, the operator walks at a steady pace and turns the blower crank the desired number of revolutions per minute. An illustration of a hand duster in operation is given in figure 5.

Sulphur dust consisting of any pure sulphur of 300-mesh fineness will give satisfactory results. Kolodust, manufactured by the Niagara Sprayer and Chemical Co., Burlington, Ont., and Electric Sulphur, produced by the Stauffer Chemical Co., Houston, Texas, U.S.A., and sold by dealers in Canada, have given excellent results at Winnipeg. Ordinary flowers of sulphur is much too coarse for disease control work.

Directions for Dusting Cereal Crops

The grower must remember that dusting is a preventive, not a cure. The efficiency of the sulphur treatment depends on the toxic effect of sulphur on the germination of the rust spores. If sulphur is present when the spores begin to germinate, it quickly kills them, but if the spores germinate and penetrate the plant before sulphur is applied, the fungus is then beyond the reach of external influences and develops normally, even if heavy sulphur applications are made

subsequently. It is evident, therefore, that if rust is to be prevented the plants must be dusted often enough to keep the new growth protected, and to maintain a continuous coating of sulphur over the older parts of the plants while they are exposed to the attack of rust. Knowing this, and the fact that rust develops and spreads rapidly during and immediately following warm and rainy weather, the grower must use good judgment in order to insure satisfactory rust control and save dust.

FIG. 5.—Hand duster in operation.

WHEN TO BEGIN DUSTING

No fixed rule can be following regarding the best time to begin dusting. Seasonal differences make it impossible to recommend a definite date which would be equally applicable in all seasons and in all parts of Canada. The most satisfactory time to begin dusting is just as soon as red rust pustules first can be found on the growing plants. This criterion can only be used with success if the grower watches closely for the early development of rust.

A more practical solution of the problem is to recommend dusting at a certain growth stage of the plant. This can be done with a good deal of confidence in the case of wheat, but not with oats and barley. In the spring wheat region of Western Canada, stem and leaf rusts, as a rule, do not become established and abundant until the majority of the wheat plants have reached the late "boot" or early "heading" stage. Each year, entirely satisfactory results were obtained at Winnipeg by applying the first dust when from 10 to 50 per cent of the wheat plants were in head. In dusting for the control of oat and barley rusts, it is necessary for the grower to watch for the early development of red rust, and to dust the plants first just as soon as a trace of the disease has appeared in the district.

Although the ordinary grain grower might be distracted by the desire on the one hand to dust early and insure rust control and, on the other hand, to dust late and save dust, the experimentalist, seed grower, or exhibitor, cannot afford to risk missing the opportunity of dusting early and obtaining the most satisfactory rust control.

RATE OF DUST APPLICATION

The most suitable rate of dust application will vary from season to season in different regions. To a large extent this rate will have to be decided by the grower according to the means employed to apply the dust, and according to the prevailing environmental conditions and the degree of rust infection, as well as by the extent of control already obtained.

For the treatment of grain plots 30-pound per acre applications are recommended. In a bad rust year like 1925 or 1927, it would be advisable to apply 45 pounds per acre at intervals of five days or, if the interval between dustings is made shorter than five days then the 30-pound rate could be used.

INTERVAL BETWEEN DUSTINGS

The most satisfactory interval between dustings is from three to six days, depending on seasonal conditions and the severity of the rust epidemic. For the protection of experimental, seed, and exhibition plots, 30-pound per acre dustings should be made at intervals not exceeding five days. In a severe rust year, it would be advisable to apply sulphur at 3-day intervals or, if the 5-day interval is used, the rate of application should be increased to 45 pounds per acre.

It is well to realize that in years when stem rust is severe, and for the control of leaf rust diseases particularly, relatively light dust applications made at close intervals will give the most satisfactory results.

TIME OF DUSTING

Since the presence of dew on the plants causes the fungicide to adhere to them better, and as early morning or late evening is usually the time of least air movement, this is the most favourable time for dusting. Whenever possible, it is advisable to dust immediately following rain, for, a heavy rain will wash off some of the protective coating of sulphur dust and expose parts of the healthy plant to the attack of rust.

Summary

Stem and leaf rusts of cereals can be prevented by dusting the growing plants with a suitable sulphur dust. The essentials for the successful prevention of cereal rusts are:

1. Begin dusting when red rust first becomes noticeable in the field. In the spring wheat region of Western Canada leaf and stem rusts of wheat, as a rule, do not become abundant until the wheat heads are starting to form. Satisfactory results will be obtained by applying the first dust at this time. It is important to watch for the appearance of leaf rust. Dusting must be commenced as soon as leaf rust has been found on the plants.

2. For small plot work, the most suitable rate of dust application is 30 pounds per acre at each application.

3. The most satisfactory interval between dustings is 5 days. The rate and frequency of sulphur dust application should be governed by the severity of the rust epidemic and the prevailing weather conditions, as well as by the extent of control already obtained.

4. It is recommended that the dust be applied in the morning or evening when the leaves are wet with either rain or dew and when there is the least movement of air. Whenever possible, dust immediately following rain.

5. A finely-divided dusting sulphur will give the most satisfactory results. At each dusting, the fungicide should be applied with an ordinary hand duster. It is advisable to treat the plants at regular intervals until the crop is practically mature.

6. In an ordinary year, 6 to 8 dustings will give very effective rust control and prevent the development of other injurious leaf and stem diseases of cereals.

Dusting for the prevention of rust is still in the experimental stage and, with the introduction of new fungicides it may be necessary to make modifications in cereal dusting methods. The methods recommended in this circular are based upon the results of experiments conducted during the past six years at the Dominion Rust Research Laboratory, Winnipeg.

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